

# Evaluation of Additively Manufactured Metals for Use in Oxygen Systems Project

Nondestructive Evaluation Program | Office Of Safety And Mission Assurance (OSMA)



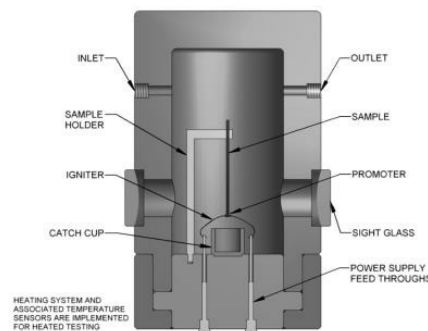
## ABSTRACT

Space Launch System, Commercial Resupply, and Commercial Crew programs have published intent to use additively manufactured (AM) components in propulsion systems and are likely to include various life support systems in the future. Parts produced by these types of additive manufacturing techniques have not been fully evaluated for use in oxygen systems and the inherent risks have not been fully identified. Some areas of primary concern in the SLS process with respect to oxygen compatibility may be the porosity of the printed parts, fundamental differences in microstructure of an AM part as compared to traditional materials, or increases risk of shed metal particulate into an oxygen system. If an ignition were to occur the printed material could be more flammable than components manufactured from a traditional billet of raw material and/or present a significant hazards if not identified and rigorously studied in advance of implementation into an oxygen system.

## ANTICIPATED BENEFITS

### To NASA unfunded & planned missions:

As the criticality of NASA and Commercial oxygen components produced by AM increases the necessity to quantify risk of ignition and flammability of these materials becomes paramount. Identifying risk areas specific to AM materials and understanding the safety implications of these risks through testing is the only way to safely implement these materials into oxygen systems. Especially as AM becomes common across industries the urgency to understand the potential risks of AM materials in oxygen systems becomes great. The results of these studies will increase understanding and help to safely implement this new manufacturing technology in oxygen systems of all applications.



NASA STD 6001B Test 17

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## Management Team

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### Program Executive:

- Brian Hughitt

### Program Manager:

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### Project Manager:

- Jonathan Tylka

### Co-Investigators:

- Ken Cooper
- Stephen Peralta

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## DETAILED DESCRIPTION

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### 1. Objectives:

Rigorously study metals produced by AM processes ignition and flammability hazards as compared to wrought metals of the comparable metallurgical composition and heat treatment for use in oxygen systems.

### 2. Technical Methodology/Approach:

(1) WSTF Oxygen Group develops and maintains the expertise and facilities to evaluate material flammability and ignition mechanisms in high pressure oxygen environments for the AM materials in question.

(2) Upward flammability testing of materials will be performed to NASA-STD-6001B Test 17 to determine if there is a significant increase in materials flammability in AM metals as compared to wrought metals of the similar chemical composition and heat treatment.

(3) Ignition tests (particle impact, frictional ignition) will be performed to determine any new or differences in AM metals ignitability as compared to wrought metals.

(4) Investigate the AM process from an oxygen compatibility perspective and provide input to the manufacturing and cleaning process of AM components to reduce hazards in the implementation of AM produced components in oxygen systems.

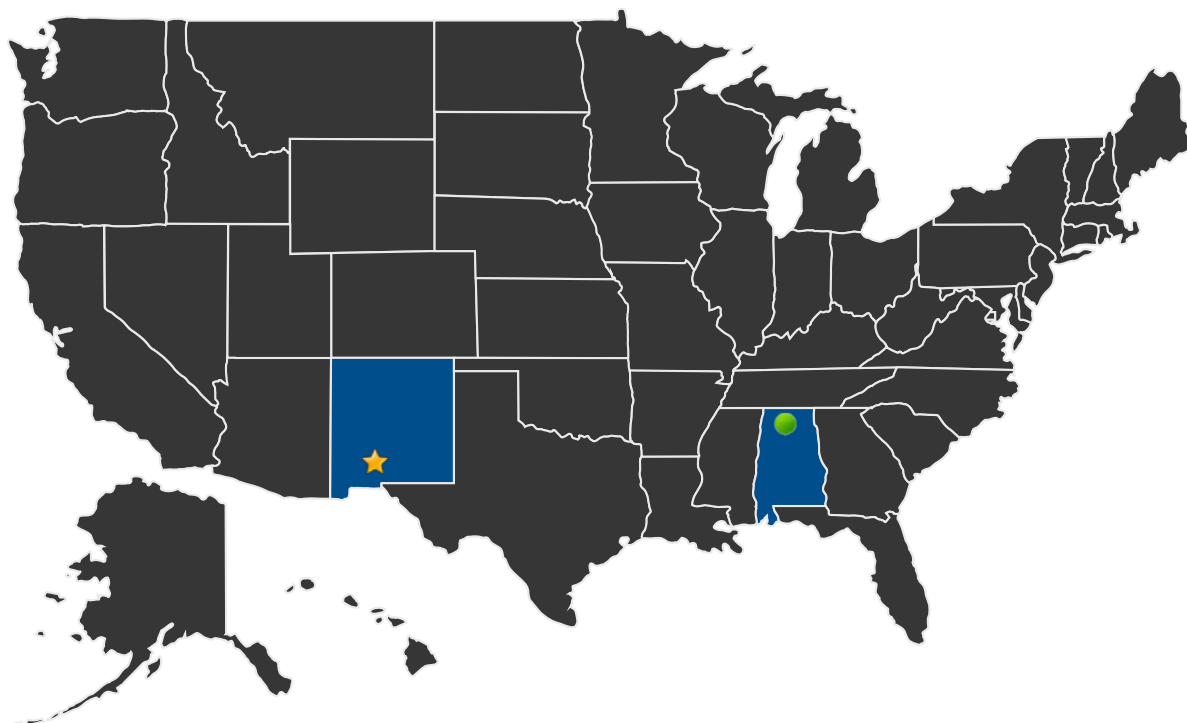
(5) Develop a guide for the use of AM processes in oxygen systems including: determination of build/post-processing parameters and their effects on ignition and flammability for specific AM alloys, recommend good practices for operating AM machines and manufactured parts for use in flight oxygen systems.

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## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work      ★ **Lead Center:**  
White Sands Test Facility

● **Supporting Centers:**

- Marshall Space Flight Center

## PROJECT LIBRARY

### Presentations

- 2016 Annual Review Presentation
  - (<https://techport.nasa.gov:443/file/20718>)